Energy supply from hydropower projects depends on rainforest conservation

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Research published in the *Proceedings of the National Academy of Sciences* shows that conserving rainforests in the Amazon River Basin will increase the amount of electricity that hydropower projects in the area can produce. The study is the first to quantify the impact of regional rainforest cover on energy production. Its findings reveal that rainforests are more critical than previously thought in generating the rainfall that drives river flow, and ultimately power production, in tropical areas. The research shows that if deforestation continues to increase in the Amazon, energy projections for one of the world's largest dams, the Belo Monte in Brazil, decline by one third.

"Our study shows that the huge strides Brazil has made in slowing Amazon deforestation are actually helping secure the nation's energy supply," says Claudia Stickler, the study's lead author and scientist at the Amazon Environmental Research Institute International Program (IPAM-IP). "But these efforts must continue hand-in-hand with conservation at the regional level."

The potential loss of generation capacity due to regional deforestation could hinder Brazil's efforts to meet its pending gap in electrical power. Specifically, the study shows that if the deforestation in the Amazon Basin goes unchecked, the energy supplied by Brazil's Belo Monte Dam – planned to be the third largest hydropower project in the world – will fall 30% below current industry estimates, an amount equivalent to the energy consumption of four million Brazilians.

"These results are extremely important for long-term energy planning," explains climatologist Marcos Costa, one of the study's authors from the Federal University of Viçosa in Brazil. "We are investing billions of dollars in hydropower plants around the world. The more rainforests left standing, the more water we'll have in the rivers, and the more electricity we'll be able to get from these projects."

Combining expertise in hydrology, ecology, land use science, climatology, and economics, the researchers modeled energy production under different levels of deforestation in the Amazon River Basin. The scenarios with more forests also produced the most power. With current deforestation levels in the region, the results show that rainfall is 6-7% lower than it would be with full forest cover. And with the 40% loss in rainforests that some predict will occur by 2050, rainfall would be 11-15% lower, resulting in 35-40% less power.

Hydropower Expansion in the World's Rainforests

"We now have very strong evidence that Brazil's ability to generate electricity depends on forest conservation," says co-author Daniel Nepstad, Executive Director of IPAM-IP. "These results aren't just important in Brazil – rainforest cover could affect energy production in wet tropical areas throughout the Amazon, and in Africa and Southeast Asia as well."

Areas with rainforests tend to have large amounts of rainfall, making them prime locations for hydropower projects that take advantage of high river flows to create electricity. The World Bank estimates that untapped hydropower in these areas is nearly four times that of installed capacity in Europe and North America – and much of this potential lies in the heart of rainforests.

"Brazil, Peru, Colombia, The Congo, Vietnam and Malaysia are all

turning to the 'green electricity' produced by hydropower to meet the demands of their growing economies," says Nepstad.

While not without controversy, hydropower usually produces fewer greenhouse gases than many other energy sources. Because of its proven technology and storage capacity, it is also currently deemed more reliable and feasible than large-scale wind and solar projects. Over 45 new plants are planned in Brazil alone, and the Belo Monte dam is expected to supply 40% of Brazil's growth in electricity production by 2019.

Integrating the Effects of Forest Cover into Energy Estimates and Land Use Planning

The new study highlights the need for hydropower planners to take regional forest cover into account when calculating the project's potential to supply electricity.

"The problem is that power plant designers typically ignore the effects of future deforestation. Or, if they do consider it, they presume that deforestation will increase the amount of water flowing to the dams," explains Stickler. "When we incorporated the effects of deforestation at the regional level, our results show quite the opposite."

The scientists urge energy planners to consider these results - and the impact of changes in rainforest cover -when assessing the viability of hydropower projects. They also urge policy-makers to pay attention to the energy costs of development efforts that clear forests for new roads and ranches, as well as the energy benefits of programs that incentivize farmers and ranchers to limit deforestation.

"In the last year, Brazil has made tremendous progress towards ending

deforestation, bringing clearing rates down to 24% of the historical average," says Nepstad. "But these numbers are starting to creep up again, and everyone should be concerned. Ending deforestation should be viewed as an issue of national energy security."

"We show that the policies that maximize conservation here also maximize power generation. It's not just conceptual, we have numbers on it," adds Costa. "This finding gives me hope. Sustainable development is not only possible, but achievable."

More information: Dependence of hydropower energy generation on forests in the Amazon Basin at local and regional scales, www.pnas.org/cgi/doi/10.1073/pnas.1215331110

Two authors also published related papers this month on the success of Brazil's deforestation polices and on market incentives used to reduce climate change and address food security issues in the region:

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